Mansion House since 1886. In most of the addresses, special aspects of study are considered, but those by Lord Playfair and Canon Browne deal with the Extension movement itself.

Men of science, as a rule, look askance at University Extension lectures. They know that there is no royal road to scientific knowledge, and believe that popular lectures of a "peep-show" kind have no place in a properly organised educational system. This is true to some extent. Popular lectures of any sort, whether delivered at the Royal Institution or in a village club, are of little use to the practical student of science. They are useful, however, in bringing people into touch with current opinions, and in creating an interest in scientific things.

The subject of Lord Playfair's address is the evolution of University Extension as a part of popular education. After people have heard lectures, they desire to found institutions in which instruction is regularly given. Out of the single and unconnected penny readings in the early part of this century grew the Mechanics' Institutes that, in the Midlands and the North, have helped on the cause of education. It was, of course, inevitable that the committees of these institutes should sometimes have had queer ideas as to the kind of programme which should be offered to the community. Lord Playfair says that one of the most prosperous of them asked him to give a single lecture on chemistry in 1846, and sent him the programme for the preceding year as an inducement to accept the invitation. It was as follows:—"Wit and Humour, with Comic Songs—Women Treated in a Novel Manner—Legerdemain and Spirit-rapping—The Devil (with illustrations)—The Heavenly Bodies and the Stellar System—Palestine and the Holy Land—Speeches by Eminent Friends of Education, interspersed with Music, to be followed by a Ball. Price to the whole 2s. 6d. Refreshments in an Anteroom." Even now, programmes of this motley character can be found at many of the large workmen's clubs in the East End, and though most educationists consider them to be "awful examples," the fact that the science lectures are usually very largely attended testifies to a desire for knowledge, which often leads to systematic study. The University Extension scheme has certainly done something to mould this demand for popular instruction. When interest has been awakened by a pioneer lecture, it becomes a comparatively easy matter to run a successful course of six or twelve lectures. And if such courses are linked together in proper sequence, it cannot be denied that advantage must accrue from them. For, to use a simile of Lord Playfair's, not only does the lecturer scatter information broadcast among his audience, trusting that some of it will fall on fertile soil, but, in the class after each Extension lecture, he acts as a tutor and is able to treat the students individually, giving each mind the attention conducive to the production of good results. The great difficulty, however, is with regard to practical work. Every man of science feels that, so far as serious study is concerned, lectures should take a secondary place in a scheme of instruction. Observations in the field, laboratory, or observatory, are absolutely necessary for a proper appreciation of the facts and phenomena of nature; and, until some provision is made for this kind of work, the science lectures will be considered little more than a form of recreation.

Sir James Paget's address is concerned with the study of science. He points out that a scientific mind should be educated in four ways, viz. (1) in the power of observing, (2) in accuracy, (3) in the difficulty of ascertaining truth, (4) in proceeding from the knowledge of what is proved to the thinking of what is probable. The subject of Prof. Max Müller's address is "Some Lessons of Antiquity," and that of the Duke of Argyll, "The Application of the Historical Method to Economic Science." The addresses are interesting from many points of view, and they help to define the *rôle* of courses of University Extension lectures in our educational system.

R. A. GREGORY.

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## *SOME RECENT WORKS ON ELECTRICITY.*

(1) *Electric Traction on Railways and Tramways.* By Anthony Reckenzann, C.E. (London: Biggs and Co.)

(2) *Portative Electricity.* By J. T. Niblett. (London: Biggs and Co.)

(3) *First Principles of Electrical Engineering.* By C. H. W. Biggs. New edition, partly rewritten and extended. (London: Biggs and Co.)

(4) *Electrical Distribution, its Theory and Practice.* Part i., by Martin Hamilton Kilgour. Part ii., by H. Swan and C. H. W. Biggs. (London: Biggs and Co.)

(5) *Town Councillors' Handbook to Electric Lighting.* By N. Scott Russell, M.Inst.C.E. (London: Biggs and Co.)

(1) THE present state of electric traction is precisely given, and the various methods and constructive details at present in use described. The best modern examples of traction are explained, with many excellent illustrations. In particular may be mentioned the proposed St. Louis and Chicago high-speed electric railway, designed to convey passengers 250 miles in two and a half hours. Much useful information has been collected from the various electrical journals and *Transactions*, and a handbook formed, which is sure to be of great service to practical men. We notice that the words "energy," "power," and "work" are used in the popular rather than in the exact scientific sense; but this circumstance detracts little from the value of the work.

(2) This little work is described as being "A Treatise on the Application, Methods of Construction, and the Management of Portable Secondary Batteries." It has been written mainly for the benefit of those who find this form of stored energy of service for economic, artistic, or scientific purposes. Part i. deals with applications to mining operations, domestic use, medical and other scientific purposes, the Army and Navy, carriage lighting, and traction and decoration. In a popular form we are presented with much information that will be very useful to anyone contemplating some of these special uses of electricity. Many of these are recent and novel, and not to be found in any other work with which we are acquainted.

Part ii. is occupied with the description and management of primary and secondary batteries and their

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adjuncts. It is an excellent small book, suitably illustrated.

(3) This is described as an "attempt to provide an elementary book for those who are intending to enter the profession of electrical engineering." In a very entertaining and humorous preface the author at once enlists the sympathy of the ordinary reader in general, and of the reviewer in particular. After its perusal the latter feels prepared to find much that is novel in treatment and revolutionary in substance in the work itself, but he finds that his anticipations are only realised to a moderate degree. The so-called "Inductive Circuit" is easily recognised as an old friend under a new name. The equation of the condenser, usually written

Quantity = Capacity × Potential-Difference,

is given by the author in the form

Accumulation × Resistance = Electrical Pressure,

wherein he regards inductive resistance as bearing the same relation to capacity that electrical resistance does to electrical conductivity. The only advantage we can see in this notion is that it brings out clearly the fact that condenser capacities combine according to the same law as electrical conductivities. Again, the author imagines the "sapient critic" to laugh at his views of "loops" and "unlooping" in connection with the lines of force of a magnetic field, and puts a question to him which he evidently regards as a poser of the first water. He says: "Your teaching involves cutting here, there, and everywhere—first in this direction, then in that; but though you tell us what happens when you cut 'lines of force,' you say nothing of what happens when your conductor leaves those lines of force. You bring your conductor to be acted upon by lines of force, but although you also take your conductor from those lines of force, you recognise no reverse action. All your cry is 'Cut,' 'cut,' 'cut,' &c., &c."

This is of course veritable moonshine. Every electrician is aware that every line of force forms a closed loop, and that "cutting" necessarily involves looping or unlooping, as the case may be, and *vice versa*, whenever the conductor forms a closed circuit.

The first principles of the dynamo are clearly and accurately given, though a worse illustration than that of a gramme ring on p. 152 is not often to be seen. However, it is good to see a clear distinction between "energy" and the "rate of its production," all the more noticeable by reason of its rarity in recent electrical books.

Notwithstanding its eccentricity, the book will be useful to a certain class of student.

(4) Mr. Kilgour considers scientifically the design of systems of distribution which shall give maximum economy with satisfactory working results. This subject was initiated by the valuable papers of Lord Kelvin and of Profs. Ayrton and Perry. In 1881 the former considered the problem of finding the cross-sectional area of copper required for a conductor to transmit a given current in order that the total annual expenditure for the energy wasted in the conductor, and for interest, depreciation, and repairs on the conductor should be a minimum. This problem is now historical. It was on this occasion, the meeting of the British Association in the year mentioned, that Lord Kelvin first brought before engineers the fact that the relation between the size of the conductor and the current strength should be governed by economical considerations. As stated by Mr. Kilgour, six quantities are involved in an important manner, viz.:—V, the pressure in volts at end of feeder near to generators; $v$, the pressure in volts at end of feeder remote from generators; C, the current strength in ampères flowing through the feeder; P, the watts delivered to feeder; $p$, the watts delivered by feeder; and $x$, the cross-sectional area in square inches of the copper of feeder. These six quantities are obviously connected by three relations; we may further assume two other relations between them, and then a sixth relation deduced from economical considerations suffices to determine the whole of the six quantities. The two assumed relations may take the form of two of the quantities being given. This is what usually happens, and is always the case in the author's discussion. Of the fifteen possible cases Lord Kelvin investigated, that in which $v$ and C are given; Prof. Ayrton, that in which V and C, and also that in which V and $x$ are given; while Prof. Ayrton and Perry, in conjunction, before the Society of Telegraph Engineers and Electricians in 1886, considered V and $p$ to be given quantities. The remaining eleven cases are completely examined by Mr. Kilgour, and in doing so, as well as by giving a clear exposition of the whole subject, he has rendered valuable service. To all those who are concerned with the design of systems of distribution, this part of the work will be found to be of high interest and usefulness. In Part ii. will be found a collection of descriptions of the systems which practical men have gradually evolved by knowledge and experience. The best mains and culverts, and also the means of maintaining them in a state of efficiency, in use in England and on the continent, are described in detail with a large number of excellent illustrations. The compilers have shown good judgment in the selections they have made from the many systems that have been adopted.

(5) This work is intended to afford to County Councillors and others similarly placed some information likely to be of use to them in dealing with questions of central station lighting. It is a small and unpretending work of some forty pages, and seems to have accomplished the object in view.

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## OUR BOOK SHELF.

*The First Technical College.* By A. Humboldt Sexton. Pp. 188. 1894. (London: Chapman and Hall.)

WHEN John Anderson became Professor of Natural Philosophy in the University of Glasgow, in 1786, he began to give instruction in science to persons engaged in industries. This was the beginning of technical education, and the future of the new line of study was to some extent provided for in Glasgow by its founder bequeathing the whole of his property "to the public for the good of mankind and the improvement of science in an institution to be denominated Anderson's University." The total value of the property, however, was only about £1000, and this, as Prof. Sexton remarks, was a small sum wherewith to start a new university which was to revolutionise the education of the country. But the gift formed a nucleus which attracted other benefactions,

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